Space Weather Technical Forecast

Issued on Thursday, 02 May 2024 at 00:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-flares likely with a slight chance of X-flares through the period. Chance of a G1/Minor geomagnetic storm days 3 and 4.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is at Moderate levels with two M Class flare, the largest a M1.9 flare peaking at 01/1443 UTC from AR3654. There are currently seven sunspot regions on the visible disc, of which six are numbered. Of these AR3654 remains the largest and most complex, although as the region is now approaching the west limb analysis is becoming harder. Two of the remaining regions, AR3662 and AR3663 have shown an increase in size and complexity, especially AR3663 which generated a M1 flare late in the period. AR3664 in the southeast is becoming gradually easier to analyse, and appears to also have a moderately complex structure.
A filament eruption beginning at 01/0600 UTC in the southwest disc close to AR3654 resulted in a notable CME signature in coronagraph imagery. Further analysis has revealed a possible Earth-directed component late on day 3 (4th), but more likely early on day 4 (5th). AR3663 emitted two narrow CME's, for which analysis is ongoing for, but currently the CME's are not expected to be Earth directed.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 were briefly at slightly elevated levels, reaching 431 km/s at 01/0025 UTC, then quickly decreased to background as initial weak CME influence eased. Density was initially above average, then declined to predominantly average levels from around 01/0500 UTC. The Interplanetary Magnetic Field remained moderate, 13nT several times through the period. The north-south component, Bz,was weakly negative at first with a minimum of -4nT at 01/0023 UTC, before rotating to a moderately positive direction from around 01/0130 UTC. Thereafter the Bz remained positive, at moderate levels for much of the time but late in the period declining to become weak. Phi angle was generally negative at first, but then from late morning rotated to become positive. Resultant Geomagnetic activity was initially Active (Kp 4) but then quickly declined to become Quiet (Kp 1-2).
Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was at background to moderate levels. The associated 24-hour fluence was well below the Active threshold. Observed fluence at 02/0001UTC was 1.21e6 integrated pfu, with a declining trend late in the day.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate solar activity is likely to continue with further M-flares likely and a chance of isolated X-flares, principally from AR3654 until the region rotates behind the west limb, but also from AR3663.

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Met Office Space Weather Technical Forecast

Solar Wind / Geomagnetic Activity: There is a risk of a glancing blow from a CME that left the Sun on the 29th, arriving sometime during tomorrow (3rd May). A notable CME that left the disc around 01/0600 UTC from the southwest disc is now expected to give a glancing blow either late on day 3 (4th) or more likely early on day 4 (5th).
Solar winds are currently at background levels (around 360km/s). A potential weak HSS connection may bring slightly enhanced wind speeds today (2nd May). Conditions are then expected to gradually return towards background tomorrow (3rd May). Then further HSS influence may wind speeds reaching elevated levels later tomorrow, then persisting through days 3 and 4 (4th and 5th May). In addition to the HSS, a glancing blow from the 1st May CME is possible from late day 3, but more likely into early day 4.
Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp 1-3) at first, but with a chance of Active (Kp 4)intervals at times due to the potential HSS and CME arrival today. From late day 3 (4th) into day 4 (5th) activity is expected to increase to become Unsettled to Active, with a chance of G1/Minor (Kp 5) geomagnetic storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels through this period. There is a chance for an S1/Minor Storm or greater event, should any proton-rich flares occur, mainly from AR3654 before the region rotates onto the far side.

High energy electron flux is expected to remain at background to moderate levels, with associated fluence expected to remain below the Active (1e8 integrated pfu) threshold throughout.

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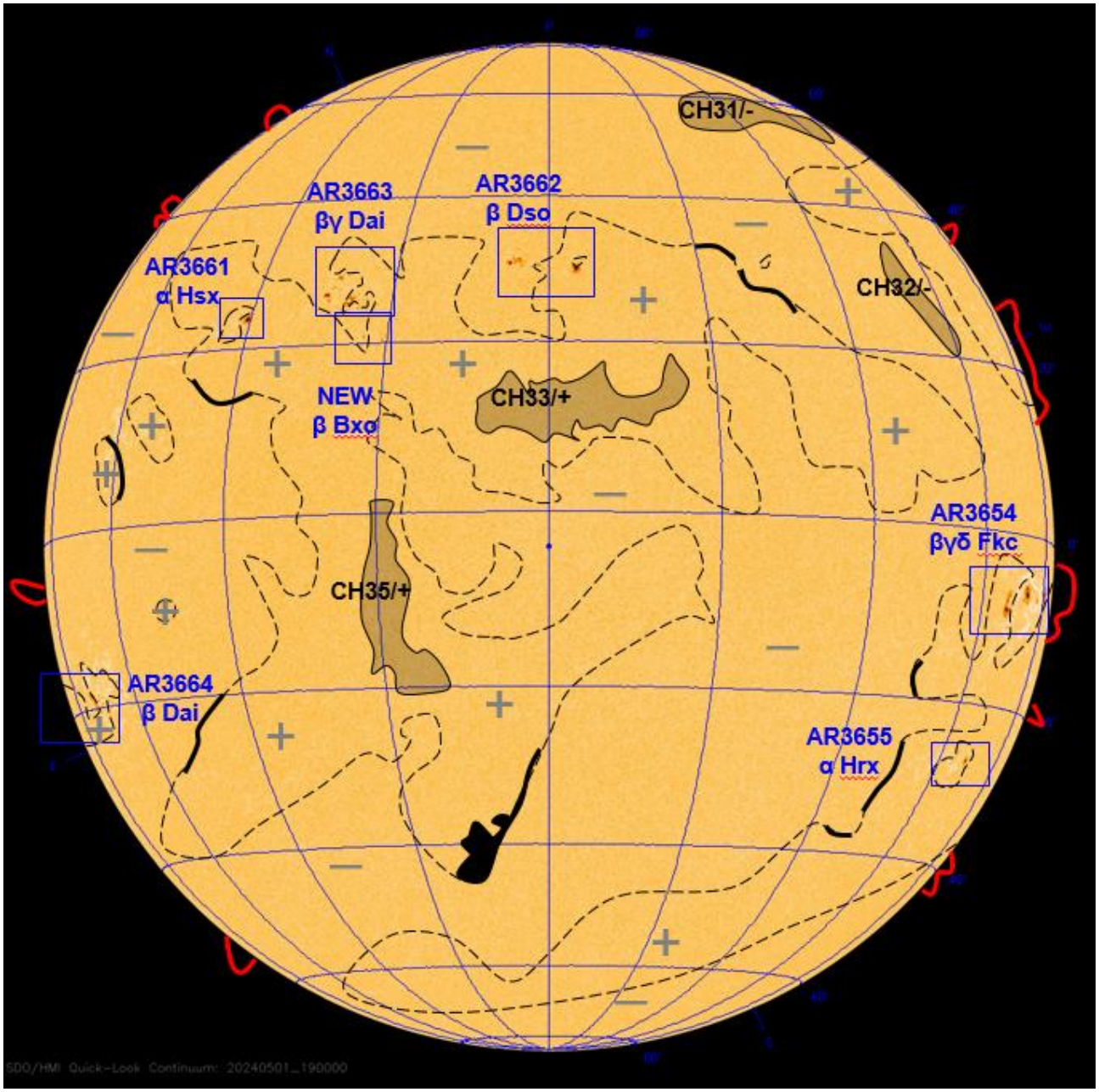
Figure 1. Solar Analysis Valid 01/1900 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

One CME currently features in the forecast period, associated with an eruption near centre disc approximately 29/0930 UTC. The CME was seen deflecting north and westwards in AIA-304 imagery. Modelling suggests the risk of a glancing blow from this feature sometime during tomorrow (3rd May). A filament eruption beginning at 01/0600 UTC in the southwest disc close to AR3654 resulted in a notable CME signature in coronagraph imagery. Further analysis has revealed potential for a glancing blow either late in day 3 (4th) or more likely early on day 4 (5th). Solar winds are currently at background levels, around 360km/s, with residual CME influence from a CME that arrived on 30 Apr. Today (2nd May) there is a potential connection from coronal hole CH34/-, perhaps bringing slightly elevated to elevated wind speeds. Conditions are then expected to gradually return towards background tomorrow (3rd May). CH32/+ and CH33/+ near centre disc in the northern hemisphere may see another increase in wind speeds towards elevated levels later tomorrow into day 3 (3rd-4th May. In addition to the HSS, a glancing blow from the 1st May CME is possible from late day 3, but more likely into early day 4. Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp 1-3) at first, but with a chance of Active (Kp 4)intervals at times due to the potential HSS and CME arrival today. From late day 3 (4th) into day 4 (5th) activity is expected to increase to become Unsettled to Active, with a chance of G1/Minor (Kp 5) geomagnetic storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	40	50
Strong	G3	No	1	1	5	10
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1259	Partial	AR3654	SW	585	05/0000 UTC	Glancing blow

Figure 2: Met Office Ensembe forecast indicating the possible range of arrival times of the 1st May CME.

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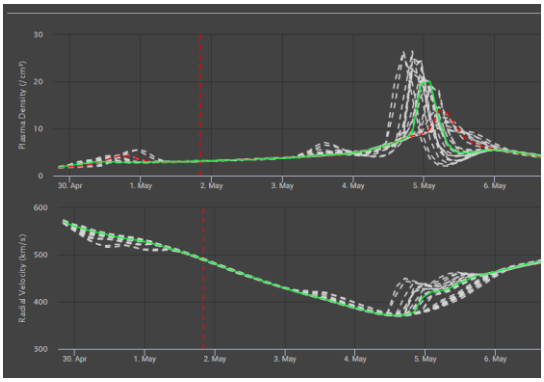

Radio Blackouts - X-Ray Flares:

There are currently seven sunspot regions on the visible disc, including recently numbered AR3664 near the southeast limb, and a new region in the northeast quadrant. AR3654 in the far west remains the largest and most active region. The region appears to be stable, although analysis is becoming harder as the region approaches the west limb. Because of this the previous classification persists, with significant complexity within its intermediate portion due to a delta spot. Remaining sunspot regions on the visible disc are all smaller and simpler in comparison, although both AR3662 and AR3663 are gradually increasing in size and complexity. AR3664 has the potential to be a larger and more complex group than indicated, which will become clearer as the region rotates further onto the disc.

There are limited signals in far-side helioseismographs for any significant oncoming regions in the coming days, but some smaller returning regions are expected, including Ex-3633 that appears close to the western horizon based on magnetic looping evident in SDO/AIA 171 imagery. Overall, the significant flare risk should decrease into day 4 (04 May) as AR3654 rotates off the visible disc tomorrow (3rd May). Overall, further M-flares are likely, with a chance of isolated X-flares, principally from AR3654 but also from AR3663.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	50	20
Very Active	R3 to R5 X Class	No	20	20	10	1

Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV) observed at GOES-18 has been at background levels and is most likely to remain that way through the period. However, there is a chance for an S1/Minor Storm or greater event today or tomorrow, should there be any large, proton-rich flares from AR3654. A slight chance of a S1 persists through day 3 (4th May), despite the region rotating over the western limb.

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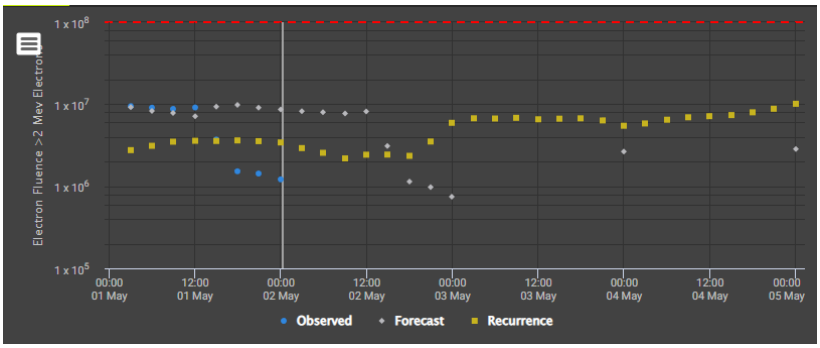
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	10	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux is at background levels. Combined minor CME and coronal hole influences through the period are likely to suppress electron flux to background to moderate levels throughout the period.
Overall, the 24 hour integrated electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, with MOSWOC REFM output a good guidance at present.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model.



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